# HERPETOLOGICA

Established 1936

Organ of the HERPETOLOGISTS LEAGUE, A.A.A.S. Associate

President, Dr. Hobart M. Smith. Vice-President, Dr. Angus M. Woodbury.
Secretary-Treasurer and Publisher, Chapman Grant,
2970 Sixth Avenue, San Diego 3, California
Edited by the Officers. Policies determined by the Members.

Vol. 6 August 15, 1950 Part 3

## A TREATMENT FOR HELMINTHIASIS IN OPHIDIA

By Dee Jay Nelson

Practically nothing has been done in the field of Reptile Therapeutics and the Herpetologist is more or less left to his own devices to diagnose and treat a particular ailment which may arise among his captive specimens. The following notes concern the successful treatment of several cases of Platyhelminthiasis in snakes of my own collection.

The causative organism was first observed as dark masses in the mouth of a specimen of *Natrix s. sipedon* Linnaeus. The snake was not particularly emaciated, which is often a later symptom of an intestinal parasite infestation. Frequent gaping, another symptom, was noted and led to the discovery of the organisms in the mouth. Microscopic examination of the viscous mouth matter revealed a type of living Trematode in great abundance. These organisms were later identified as probably *Lechriorchis tygarti* (Fig. 1). The parasite measures up to 5 mm. in length, is semi-transparent except for the uterine canal which contains hundreds of eggs which are about 10 microns long and ovaloid in shape. The entire egg mass shows up as a brownish area to the unaided eye. The body is about one fourth as wide as long and possesses two suckers. The ventral sucker is about twice as large as the oral and is located at about midbody. An exact identification is not necessary because treatment is effective against a variety of allied forms of worm.

Often the organism may be present in the lower digestive tract and not in the mouth. They may however often be detected by introducing a quantity of slightly warmed egg albumen into the stomach by means of a male catheter attached to a hypodermic syringe. The organisms if they be of a small type such as I encountered in these instances will be removed in numbers with the egg white as it is drawn back into the syringe.

TREATMENT - Carbon tetrachloride which has been used extensively as an antihelminthic is quite toxic and causes violent reactions and even death in some cases. I have found 0.2 cc of tetrachlorethylene per two pounds of body weight very effective.

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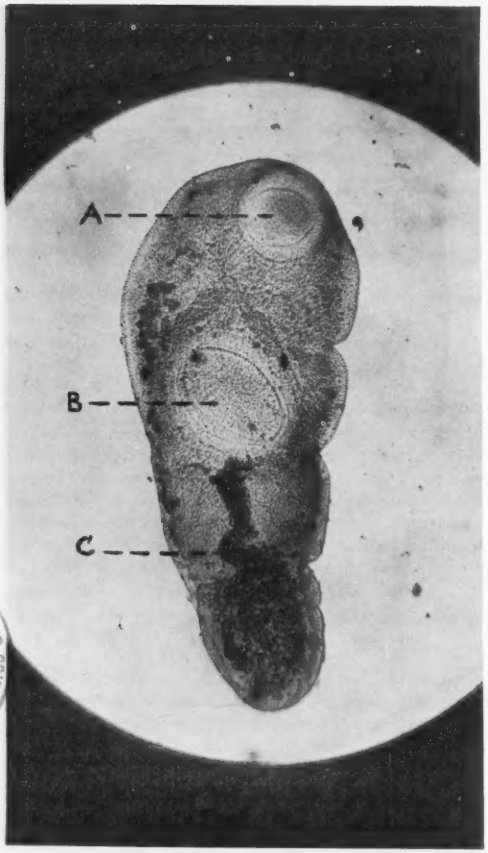


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Fig. 1. *Lechriorchis tygarti*, a parasitic flatworm from the mouth of *Natrix s. sipedon*. "A" indicates the oral sucker. "B" is the ventral sucker. "C" is the urethral canal containing eggs.

Administer the drug in capsules only. Dosage is based on that given for the domestic cat and fox cubs. Give at least four days after feeding as this drug is absorbed by any fats that may be present in the stomach. Care must be taken not to rupture the capsule in the mouth as tetrachlorethylene is inclined to strangulate. I recommend forcing a little water down after the capsule as a vehicle to carry it to the stomach. After treatment the snake should be left alone and quiet for two or three days with plenty of water in the cage. There will probably be some disturbing reactions to the treatment such as slow and somewhat weakened response to handling. Breathing may also be a bit labored at first. Do not give another dose sooner than three weeks and then only if the first was definitely insufficient. Never give a third, or permanent damage may be done to the liver which is somewhat effected by the drug. In the *Natrix s. sipedon* mentioned earlier, a specimen of *Coluber f. flagellum* Shaw, and also an example of *Natrix sipedon pictiventris* Cope, approximately 80% of the worms were eliminated after the first and only treatment. The surviving organisms will usually cause little trouble and the host should gain in weight rapidly. These and most other types of intestinal flat-worm require an intermediate host higher or lower in the evolutionary scale than the animal infected so there is very little chance of reinfection or communication to other cagemates.

Tetrachlorethylene is used commonly in combating Ascaridiasis and Ankylostomiasis but as has been noted seems successful in the presence of Trematoda. It is not effective in Cestoda.

Trematodic parasites often invade the lungs of snakes as well as the digestive system but as yet no treatment has been suggested in such cases.

Turtles are often infected with a similar organism; *Eustomos chelydrae*, which can probably be eliminated by the above method. There still remains much work to be done adapting various known veterinary remedies to reptiles.

I wish to thank Dr. C. L. Heath, D.V.M. for his assistance in the identification of the organisms and the suggestions which he has freely contributed to the preparation of this paper.

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*COLUBER CONSTRICTOR MORMON* — A STATE RECORD FOR ARIZONA.—A specimen of *Coluber constrictor mormon*, BYU No. 100, from Eager, Apache County, Arizona, was collected by Homer Wakefield on May 10, 1927. Dr. Vasco Tanner assured me in private conversation that the locality data were undoubtedly correct. It was to be expected that the species would eventually be added to the state fauna. Another BYU specimen, No. 694, was collected from Boulder Dam, Nevada, and the snake may eventually be found on the Arizona side of the river.

—Frederick A. Shannon, Wickenburg, Arizona

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# INSULAR VARIATION IN THE LIZARD *SPHAERODACTYLUS CINEREUS*

By M.B. Mittleman

For many years the small, brightly crossbanded gecko of the Antilles and the Florida Keys was known as *Sphaerodactylus elegans* MacLeay. Although the belief has gradually become fairly universal that *elegans* is probably the immature form of *Sphaerodactylus cinereus* Wagler, it remained for Grant (1948) to demonstrate conclusively that *elegans* and *cinereus* are actually ontogenetic forms of the same species. In confirming the general supposition, Grant's work makes mandatory the suppression of *elegans*, type locality Cuba, in favor of the older *cinereus*, type locality Haiti, insofar as the Cuban and Haitian species are deemed identical. However, suppression of *elegans* and subsequent use of *cinereus* for the lizards of both islands can be maintained only if it can be shown that this identity exists, for despite the fact that the "*elegans*" form (i.e., the crossbanded juvenile) is but a pattern variant which occurs in both island populations, the name *elegans* was based on a Cuban specimen. Thus, if the Cuban population differs from the Haitian one, the name *elegans* must be retained for the Cuban species, while *cinereus* can be applied only to the Haitian form.

In the same paper (op. cit.), Grant reported on a comparison of 31 males, 44 females, and 18 juveniles from the Harvard Arboretum near Cienfuegos, Cuba, with a series of 19 males, 34 females, and 2 juveniles from the Cul-de-Sac Plain near Port-au-Prince, Haiti. Grant considered the Cuban and Haitian populations to be identical, and concluded that the Cuban adults "seemed to average 2 mm. longer. . . . . .but this may be due to the difference in preservative used. The Haitian series seemed to have a greater tendency to retain head and body stripes, but the difference was not significant." I have had the opportunity of examining the Cuban and Haitian specimens studied by Grant, thanks to his kind generosity, and after a detailed scrutinization of them I find that scale counts and measurements do not confirm the concept of conspecificity. There are four characters (at least) which serve to separate these two insular forms: (1) number of dorsal scales contained in the standard length; (2) number of ventral scales contained in the standard length; (3) number of lamellae under the fourth toe; and (4) proportionate head length.

A total of 65 adult Cuban specimens (37 males, 28 females), and 45 Haitian specimens (22 males, 23 females) was studied. In all cases except where obvious gravidity was present, sex was determined by dissection. Various authors have pointed out certain dichromatic and morphologic differences between the sexes; while these differences hold true in a good number of cases, dissection proves that there is sufficient deviation to require internal examination for absolute verification of sex.

None of the four diagnostic characters studied appears to be significantly associated with sex or age, so that the comparisons made herein between the two populations are predicated on the pooled data for adult specimens of both sexes. As used here, "adult" refers to non-banded specimens, i.e., specimens in the unicolor or spotted phase.

DORSAL SCALES

Dorsal scale counts discussed here refer to the number of dorsal scales contained in the "standard length," which by custom is defined as the distance from the tip of the snout to the center of the eye. In making these counts it was found best to count scales lying a few rows lateral of the dorsal midline, since these Sphaerodactyli tend to have slightly diminished, rather irregularly-sized scales along the vertebral line. In 65 Cuban specimens the dorsal scale count varies from 16 to 19, mean 17.33± 1.06; in the 45 Haitian specimens the variation is from 18 to 24, mean 20.88± .933. These differences in range and mean are highly significant, since the difference between the means contains its standard error 17.8 times. A count of 16 - 19 is found in all 65 Cuban specimens, while a count 20 - 24 distinguishes 42 out of 45 Haitian specimens. Hence, 107 specimens of both populations, out of a total sample of 110 individuals, can be properly allocated as to geographic origin on the basis of the dorsal scale count.

VENTRAL SCALES

Ventral scale counts discussed here reflect the number of ventrals contained in the standard length. In 65 Cuban specimens the ventral count range is from 9 to 11.5 and the mean is 10± .54; a variation of 9 to 13 is found in 45 Haitian specimens, the mean being 11.5± .943. Again, these differences are very significant, since a value of 10.6 is obtained when the differences between the means is divided by its standard error. Out of 45 Haitian specimens, 39 have ventral count of 11 - 13, while a count of 9 - 10.5 is characteristic of 56 out of 65 Cuban examples.

LAMELLAE OF TOE IV

The lamellar count of Toe IV proves to be statistically significant in differentiating between Cuban and Haitian specimens, although not as sharply diagnostic as the dorsal and ventral scale counts. The lamellar variation in 65 Cuban specimens is 13 - 16, mean 14.96± .633, while in 45 Haitian specimens the range is also from 13 to 16, but the mean of the sample is 14.22± .664. The statistical significance of this difference is supported by a value of 5.9 as a result of dividing the difference between the means by its standard error. A lamellar count of 15 or 16 distinguishes 55 out of 65 Cuban specimens, while a count of 13 or 14 is found in 35 out of 45 Haitian specimens.

PROPORTIONATE HEAD LENGTH

Head length is measured as the linear distance from the tip of the snout to the posterior border of the ear opening. Although newly-hatched specimens tend to have relatively longer heads

Fig. 1.-*Sphaerodactylus elegans* MacLeay, Harvard Arboretum, near Cienfuegos, Cuba. The upper series shows the transition from the juvenile banded form (*S. elegans,* of authors) to the adolescent banded and spotted phase (*S. intermedius* Barbour & Ramsden). The lower series (three specimens at left males, three specimens at right females) demonstrates the normal adult pattern for this species; note that the adult females retain vestiges of the longitudinal stripes at least anteriorly. The same type of pattern ontogenesis is found in *Sphaerodactylus cinereus* Wagler. Millimeter rule at left. Photograph through the courtesy of Major Chapman Grant.

than do more mature individuals, no significant trend is apparent in sexually mature specimens. In 65 Cuban specimens the ratio of head length to snout-vent length (HL/SV) varies from 23.4% to 26.5%, mean 24.57± .65, with 57 specimens having the HL/SV ratio 25.7% or less. By contrast, in the 45 Haitian specimens the HL/SV ratio varies from 25.0% to 28.7%, and averages 26.12± .777; the HL/SV ratio is 25.8% or more in 37 specimens. Again the difference between the means is strongly significant, since the difference is 11.3 times its standard error.

As indicated by Major Grant (op. cit.), Cuban specimens average longer in snout-vent length than do examples from Haiti. In the Cuban series discussed here, I find a snout-vent (SV) length variation of 29 to 38 mm., mean 34.22± 1.91. The Haitian series varies from 29 to 35.5 mm., mean 32.50± 1.45. Here again a significant statistical difference is found, for the difference between the means is 5.12 times its standard error. The SV length of cross-banded ("*elegans*" phase) specimens in the Cuban series varies from 16 to 23 mm. One of Major Grant's newly-hatched Haitian specimens is 15.5 mm., SV length, while I found an egg at Key West, Fla., containing a specimen very nearly ready to hatch, with a snout-vent length of only 13 mm.

In Cuban specimens the crossbands commence to break up, and are represented mostly by narrow, irregular, light transverse streaks, or more properly series of light dots, at about 23 or 24 mm. SV length (this stage is reached at about 20.5 mm. SV length in Haitian specimens); at this size, the head is rather dark, with only faint suggestions of light crossbands. From about 24 mm. to 29 mm. SV length in Cuban specimens, the remnants of the crossbands diminish progressively, due to the enlargement in size of the small clusters of melanins, so that ultimately (at 30 to 31 mm.) the erythrins which formerly comprised the red ground color of the newly-hatched young are reduced to mere light flecks which impart a finely-dotted or streaked appearance on a darker background. In some specimens the overall impression is of a fairly uniform light brown or tannish animal; in others the pattern is of the salt-and-pepper type, or else boldly lineate. Generally, lineations are restricted to the head, neck, and shoulders; in occasional specimens, usually 31 to 34 mm. SV length, the lineate pattern extends to the base of the tail (as in the nominal *Sphaerodactylus intermedius* Barbour & Ramsden, from Cuba). No significant difference is to be found in the colors or pattern of Haitian specimens, except for a somewhat greater intensity of the dark pigments.

Any one of the several characters discussed here will correctly separate as to geographic origin at least 80% of the specimens studied. Taken in combination, these several variables will properly allocate geographically over 90% of the specimens studied. I have had only four specimens available for this study, from Key West. These are very uniform in their various characters, and agree in all respects, save the lamellar counts in two individuals, with the norms for the Haitian population as reported here. One would expect the Key West form to be identifiable with the Cuban population, in view of the proximity of the two islands;

however, many herpetologists hold that Key West geckos have been introduced, and if so the original immigrants may well have come from Haiti. It should be noted that although *Sphaerodactylus cinereus* (sensu lato) has been recorded only from southern Florida, Cuba, Hispaniola, and Navassa, it is entirely possible that it occurs on other Antillean islands. Whether such other insular populations will be identifiable with that of Cuba or the Haitian one, or distinguishable in their own right, is a matter of speculation. Biometric analysis may possibly differentiate undescribed insular forms, but the heavy inter-island traffic by man from early pre-Columbian days up to the present has not in any way simplified the taxonomic problem, since fortuitous immigration has doubtless occurred many times, with resultant contamination of previously pure genetic strains.

In view of the several differentiating characters that separate the Cuban and Haitian populations, I conclude that they are taxonomically distinct. The name *Sphaerodactylus cinereus* Wagler is applicable to the Haitian form, while the name *Sphaerodactylus elegans* MacLeay must be used for the Cuban population. Despite obvious superficial similarity and a statistical overlap in various diagnostic characters, I do not use the trinomial for *elegans* and *cinereus*. There is a widespread tendency to use the subspecific, or trinomial, designation to indicate apparently close relationships, but I do not subscribe to this school of thought. It seems to me that the subspecific rank should not be used as a matter of personal fancy. Even granting the accusation of deprecative critics that taxonomy is largely a "science of convenience," there must (or should) be some universal criterion or set of criteria, by which to determine whether or not a population is specifically or subspecifically related to its congeners. As used today, the trinomial (according to the case) indicates variously a subspecies (e.g., a population in allopatric relationship to other populations of the same species) which physically intergrades with other subspecies of its species; or a population not sufficiently differentiated from another population so as to afford 100% identification of all known individuals on the basis of one or more arbitrary criteria; or else the trinomial expresses its user's theories on the phylogeny of the forms with which he is concerned.

The very fact that at least three different interpretations attach to the use of the trinomial seems to me to considerably weaken its usefulness. For example, if the criterion of actual physical intercourse between adjacent populations (with resultant intergrades being produced) is used as the determinant of the subspecific versus the specific rank, then the use of the trinomial (supposedly indicative of the subspecies) for apparently related insular forms is devoid of meaning. Alternatively, if the decision as to specific or subspecific rank, and hence the use of the trinomial, is predicated upon the "degree" of difference exhibited in one or more characters by two populations, the trinomial and with it the subspecific concept is again robbed of real meaning. Obviously, even when two populations are only 75% separated by

one, two, three, or more unitary traits, it is still theoretically possible to discover other characters which would afford 100% identification of the individuals comprising the two populations. Many systematic differences are based on external, and often superficial, characters. Any taxonomist would be willing to grant that the conscientious comparison of samples from possibly different populations, if utilizing every possible basis of comparison--both external and internal, proportional and absolute, macroscopic and microscopic--might well bring to light one or more criteria affording complete identification of all individuals in any two samples under direct comparison. Since this is not practical in most instances, the more accessible and utilizable external criteria form the basis of judgment usually as to whether or not the two populations are completely separable. Thus, any two populations that were, say only 75% separated on the basis of X number of unitary variables would be considered by many workers to be subspecifically related, regardless of whether or not the opportunity for (and the act of) genetic intercourse exists. The subspecies then, under such a system is a category resulting from the arbitrary determination of degree of separation (or overlap) of one or more "critical" characters. But the fallacy of this system is apparent in that consistency would require full specific rank for the populations involved if a character (or characters) of sufficient "importance" were subsequently found which proved infallible in separating population "A" from population "B"--regardless of the overlap of previously-determined traits. Adherence to this method inescapably requires one to inquire as to the tenability of "degree of difference" as the subspecies criterion, and the actual intent and meaning of the trinomial.

Although I have read many discussions of the "subspecies problem," I have found no simpler nor more satisfactory statement of principle for the practicing taxonomist than Blanchard's classic contribution (1925):

> "To the writer, a species is a population of similar individuals of similar habits, freely interbreeding and maintaining a high degree of constancy in most superficial as well as all fundamental details throughout a generally considerable area. An unusual local emphasis on minor features is not regarded as of taxonomic significance. A subspecies is of the same nature as a species except that it intergrades with a closely allied race in a relatively narrow area where the two ranges adjoin."

The contentious critic may quibble over what constitute minor or fundamental differences, but in the main, Blanchard's thesis with respect to the recognition of the subspecies appears to me to provide a lucid and definite criterion. It is this principle to which I have adhered in the past as well as in the present instance. Blanchard's rule for the determination of specific or subspecific stature has a vast superiority over other methods insofar as it bypasses personal criteria, and variable and perhaps unstable interpretations are thereby avoided. It is, of course,

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not necessary to slavishly follow Blanchard's or any author's proposals; however it does seem to me very desirable that some sort of standardization of practice be initiated and adopted by the majority of workers. I suggest that Blanchard's definitions make a good starting point.

## LITERATURE CITED

Blanchard, Frank N. 1925 A key to the snakes of the United States, Canada and Lower California. Pap. Mich. Acad. Sci. Arts and Letters, 4 (2): xiii + 1 - 65, figs. 1 - 78.

Grant, Chapman 1948 Pattern changes in *Sphaerodactylus* and a comparison of Cuban and Haitian series of *S. cinereus*. Jour. Ent. Zool., 40 (4): 69 - 71, 2 figs.

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## A SNAKE DEN IN TINTIC MOUNTAINS, UTAH

By A. M. Woodbury and Richard M. Hansen

Ten year studies of a snake den in Tooele County, Utah, by the senior author led the writers to comparative investigations of another snake den in Tintic Canyon, Juab County, Utah. This den was discovered by sheep herders in 1937, who, with the aid of workers from a Civilian Conservation Corps camp, killed an estimated 300 rattlesnakes and blasted the entrance in an effort to seal the den opening.

Preliminary investigations in the spring of 1949 disclosed that the entrance had not been sealed and snakes were still using the den. Later, loose rocks at the entrance were removed and it was determined by use of a wire that cracks penetrated underground rocks at least 15 feet. At least 5 species of snakes were using the den for winter hibernation.

The general nature of snake dens, in which snakes hibernate underground for protection against winter climatic extremes, is well established but more complete understandings await further investigations. Hall (1929:79) described a den in eastern Nevada. A snake hunt near Pateros, Washington, in May, 1930, that netted a large catch of rattlesnakes emerging from a hibernating den was described by Martin (1930:77). Woodbury has been working with snake dens in Utah and western Colorado since 1935.

Indications that frogs may hibernate in aggregations in the mud of certain springs or ponds and that they may regularly use certain pathways to and from winter quarters was given by Hope (1941:46). Descriptions of several rattlesnake dens in South Dakota were given by Gloyd (1946:87-97). Further observations of dens in South Dakota were described by Anderson (1947:1-2).

A study of a rattlesnake population in California, where the snakes did not appear to aggregate in dens was described by Fitch and Glading (1947:103-123). The use of long horizontal tunnels for dens by the desert tortoise was described by Woodbury and Hardy (1948:145-200).

The Tintic den (6300 feet altitude) is located in the right fork of Tintic Canyon which drains the west slope of Tintic Mountain (8214 feet) and opens into Tintic Valley (5500 feet). The den site lies a few yards north of a small branch of Copperopolis Creek which is fringed with rabbit brush, *Chrysothamnus;* choke cherry, *Prunus;* and willows, *Salix.* This streamside vegetation is bordered by narrow strips of sagebrush, *Artemesia* along the bottom and these in turn are bordered by loose open stands of juniper, *Juniperus utahensis,* which occupy most of the rocky slopes of the canyon sides.

On September 10, 1949, the den was enclosed by a circular fence of screen wire cloth 30 inches high. The enclosure was about 20 feet in diameter and contained 2 traps set into the fence to catch snakes returning to the den. The traps, made of the same material, were 15 x 15 x 30 inches in size with a funnel shaped opening pointing inward from one end and a door for removal at the other end.

An unknown number of snakes, at least 3 in number, had returned to the den at the time the fence was installed. Eight trips were made to the den between September 10 and October 23. On 6 of these trips, 127 snakes of 5 species were captured in the traps. These were sexed, measured, palpated for eggs, and recorded. Of these, 100 were released inside the fence and 27 were taken to the laboratory for study. The five species included: Great Basin Rattlesnake, *Crotalus viridis lutosus;* Western Striped Racer, *Coluber taeniatus taeniatus;* Great Basin Gopher Snake, *Pituophis catenifer deserticola;* Western King Snake, *Lampropeltis triangulum gentilis;* Great Basin Garter Snake, *Thamnophis ordinoides vagrans.*

The following tabulation shows the number of each sex of each species taken on each date the den was visited. The totals include the number of eggs that were found by palpating the abdomens of the female rattlesnakes.

TABLE I

| | September | | | | | | | | October | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13 | | 18 | | 25 | | 2 | | 9 | | 16 | | Totals | | No. of Eggs | Total for Sp. |
| | M | F | M | F | M | F | M | F | M | F | M | F | M | F | | |
| Rattlesnakes | 2 | - | 6 | 6 | 17 | 12 | 5 | 2 | 4 | 5 | 5 | 5 | 39 | 30 | 45 | 69 |
| Striped Racers | 1 | - | 6 | 4 | 1 | 1 | 2 | 2 | 6 | 4 | 11 | 14 | 27 | 25 | - | 52 |
| Gopher Snakes | - | - | - | - | - | - | 1 | - | 1 | - | 1 | - | 3 | - | - | 3 |
| Garter Snakes | - | - | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | - | 2 |
| King Snakes | - | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | 1 |
| | | | | | | | | | | | | | | | Den Total | 127 |

All snakes were routinely measured for body length and total length. Body length measurements of rattlesnakes and striped racers were used to plot the accompanying graphs, which show the number of each sex plotted against body length. These graphs in general show the same tendencies as the graphs derived from the ten year study of a den in Tooele County (which will be reported separately) but specific details do not entirely agree.

In both species, the males grow larger than the females. This is indicated by the body lengths plotted on the graphs but it is more obvious in the field. In the rattlesnakes, the males reach maximum body length about 6 inches longer than the females. It is obvious from the graph that there are many more large than small rattlesnakes that winter in the den. Peak numbers for females occur at 27 inches and for males at 35 and 36 inches. If body length is any criterion of age, this indicates that there are many more older rattlesnakes that use the den than younger ones. This tends to corroborate the idea developed in the ten-year study that few of the young snakes utilize the den in the first years of their life but more of them tend to enter in later life.

In the striped racers, the males reach a maximum body length about 5 inches longer than the females. It is not so obvious from the graph that there is a larger number of larger and older striped racers as indicated for the rattlesnakes but when it is considered that it would require a much larger population of young snakes to maintain such a supply of large snakes, it becomes obvious that a very small percent of the young snakes utilize the den for winter hibernation.

From palpation of the abdomens of the female rattlesnakes, it was determined that only 6 out of the 30 captured were gravid. These 6 contained 11, 7, 6, 7, 6 and 8 large eggs respectively, making a total of 45 eggs developed during the preceding summer that will be ready for reproduction the next summer. These eggs will be carried in the ovary during hibernation and will enter the oviduct about June, 1950. These 45 eggs represent the potential egg crop for the following year, which is a breeding potential of about 64 percent of the total rattlesnake population for the year 1950. A similar estimate from the ten year study indicated nearly 100 percent potential for the year 1949 in Tooele County.

At present, the den population of rattlesnakes is known to have been 70 in the Tintic Canyon Den in the fall of 1949. When the sheepherders and CCC boys found the den in 1937, it was estimated by one of the sheepherders (who claimed to have taken personally 135 sets of rattles) that a total of about 300 rattlesnakes were killed at that time. If this is true, the rattlesnake population has not fully recovered from that early decimation in 12 years.

## BIBLIOGRAPHY

Anderson, Paul 1947 Observations on the denning habits of the prairie rattlesnake, *Crotalus viridis viridis* (Rafinesque). Chicago Acad. Sci., Nat. Hist. Miscellanea, No. 9:1-2.

Figure 1 RATTLESNAKES

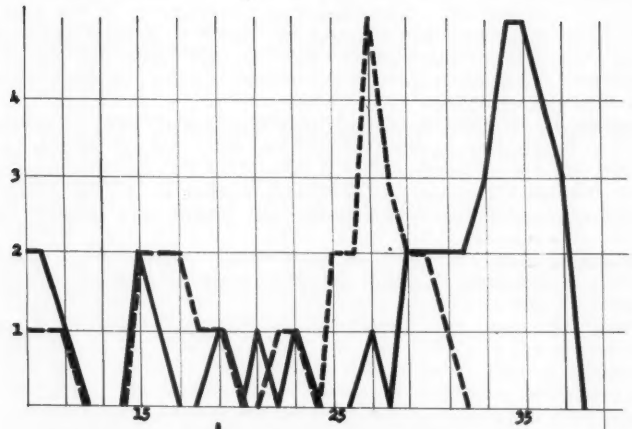


Figure 2 STRIPED RACERS

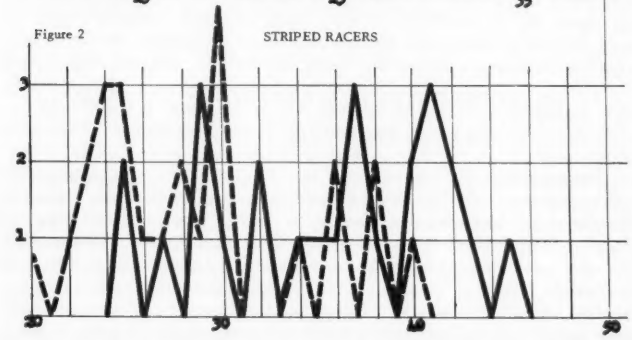


Fig. 1 and 2. Broken lines represent females, continuous lines represent males. The numbers of each species are plotted against body length in inches.

Fitch, Henry S. and Ben Glading 1947 A field study of a rattlesnake population. Calif. Fish and Game, 33:103-123.

Gloyd, H. K. 1946 Some rattlesnake dens of South Dakota. Chicago Naturalist, 9:87-97.

Hall, E. Raymond 1929 A den of rattlesnakes in eastern Nevada. Bull. Antivenin Inst. of America, 3(3):79-80.

Hope, Lawrence 1941 The Life of the Frog. Wisc. Cons. Bull., 6(2):46-48. Described from observations in the field. Describes frogs coming to "dens" in special pools or springs for winter. One "frogger" took 280 lbs. of Leopard Frogs in 4 hrs. without moving, as frogs came in to winter.

Martin, P. J. 1930 Snake hunt nets large catch, Bull. Antivenin Inst. of America, 4(3):77-78, Dec., Annual hunt on E. side of Methow River, 6 miles N. of Pateros, Washington, in Okanogan Co. nets large number in May as snakes emerge from hibernation and before they scatter for summer.

Woodbury, Angus M. and Ross Hardy 1948 Studies of the Desert Tortoise, *Gopherus agassizii*, Ecol. Monographs, 18:145-200.

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## BREEDING DATES FOR *AMBYSTOMA TEXANUM*

By L. W. Ramsey and J. W. Forsyth

Bishop, quoting Strecker in his "Handbook of Salamanders," indicates that the breeding season for *Ambystoma texanum* (Matthes) in northeastern Texas is during the first ten days of March. The following observations may therefore be of interest. For the past three years the writers have taken this salamander in Tarrant County, Texas, during or soon after periods of heavy rainfall, in the months of January and February. The specimens were found in shallow ponds, borrow and roadside ditches, and a few were taken while crossing the road during heavy rains. Usually they were found singly in the shallow water near the shores of the ponds. No mating or courtship behavior was observed.

Three females taken February 25, 1948, laid a quantity of eggs in the laboratory during the night. Another group taken January 13, 1950, consisting of both males and females, were kept in an aquarium for a while. Eggs were laid January 14, 15, and 16 and subsequently began development, some hatching as early as January 25 in the laboratory. It appears therefore that at this latitude these salamanders breed from mid-January to March, depending upon suitable weather conditions.

# OBSERVATIONS ON THE COURTSHIP BEHAVIOR OF *THAMNOPHIS SIRTALIS SIRTALIS*

By James C. List, Jr.

Three garter snakes, *Thamnophis sirtalis sirtalis* (Linn.) *nec* Klauber, all captured in the same wooded area within the city limits of South Bend, Indiana, repeatedly exhibited a courtship behavior in the laboratory shortly after capture. Although the general features of the behavior closely parallel the description by Blanchard and Blanchard (1942), which is considered typical of *Thamnophis*, the possibility should be kept in mind that since these snakes were newly captured and in highly unnatural surroundings, the details of their behavior may well have been altered.

The first snake captured was a male (560 mm in length, 42 grams in weight), taken March 24, 1949. It was brought to the laboratory and placed in a wire screen cage (13 x 8 x 7 inches). A female (670 mm in length, 76.5 grams) was caught the following day in the same locality. She was placed in the cage with the male, and the latter began his courting actions almost instantly. The female, however, seemed completely indifferent to the activities of the male, and remained so throughout the period of observation. For the first several minutes in the cage she moved about rapidly, nosing the screen and corners of the cage. Later she became somewhat more quiet but continued to move about slowly.

The male's activities, on the other hand, continued undiminished six hours after the female was introduced into the cage. Observations were discontinued at that point. At no time during this six hour period was any attachment noted. This appears to substantiate Blanchard and Blanchard's (1942) contention that Davis (1936) had reported a good description of courtship for *Thamnophis radix* but probably had not observed copulation, having misinterpreted courtship for actual mating.

The male's behavior followed a general pattern: he would bring his chin in contact with the back of the female and immediately begin crawling forward, following the curves of her body and aligning himself with them (Fig. 1A), sometimes lying across the female at one or two points (Fig. 1B). His chin was rubbed against the female as he moved and his body was continually in motion with rhythmic, rippling, lateral undulations. Occasionally more vigorous and convulsive lateral movements would push the female to one side or the other. The male usually stopped his forward movement with his head an inch or two behind that of the female. By this time the posterior one-third of his body was entwined to some extent with that of the female (Fig. 1C), and the vents of the two were approximately side by side. He then turned the ventral surface of the cloacal region of his body to one side

(toward the female) or even to a dorsal position, apparently in an effort to bring it into contact with the corresponding surface of the female. This turning of the male's ventral surface toward the female sometimes involved not only the cloacal region but the greater part of his length (Fig. 1D).

No cooperative turning by the female was noted. During all this time she kept moving about in the cage and sometimes pulled away from at least the head of the male. When this happened the latter would quickly swing his head toward the female again, and as soon as his chin had contacted her the forward movement and chin-rubbing would again take place. Occasionally after touching the female he began rubbing his chin along toward the tail. He seldom progressed more than five or six inches in this direction, however, before reversing himself and moving back toward her head.

All this activity took place in the close presence of several observers. The first photographs (Figs. 1C and 1D) were taken about two hours after the snakes were put together. Later the two were removed from the cage to an open wooden box in an attempt to get clearer photographs (Figs. 1A and 1B). This produced only a brief interruption of the male's courtship.

The next morning found both snakes quiet and the male displaying no interest in the female.

Three days after the capture of the female another male garter snake was caught (593 mm, 42.5 grams), again in the same locality. When placed in the cage with the other two snakes he immediately began courting the female. His actions were identical with those of the other male. The female again was unresponsive, and no copulation was noted during four hours of observation.

The first male, however, which had shown no interest in the female during the preceding two days, now began half-hearted attempts to court her. Inasmuch as the renewal of attention followed but a few minutes after the introduction of the second male, it is suggested that the latter's courting activity may have stimulated a similar reaction in the first male. Some chin-rubbing and body undulations took place, and he occasionally crowded away the second male. This revived interest lasted only an hour.

On the following morning both males were quiet, and neither showed any more interest in the female.

As a concluding note it may be mentioned that the female gave birth to eighteen young on July 6, 104 days after her capture. From the data supplied by Blanchard and Blanchard (1941) it appears that this period of 104 days would be within the normal range of development, had copulation occurred with the first male. Although copulation may have ensued after observation ceased, it is more likely that the female had mated shortly before being captured since she seemed to refuse mating during the six hours courtship was observed. Blanchard and Blanchard (1942) pointed out that "there seems to be a tendency for recently mated females to avoid another copulation immediately."

For about a week before the birth she was unusually restless and refused food. No record of temperature was taken, but the

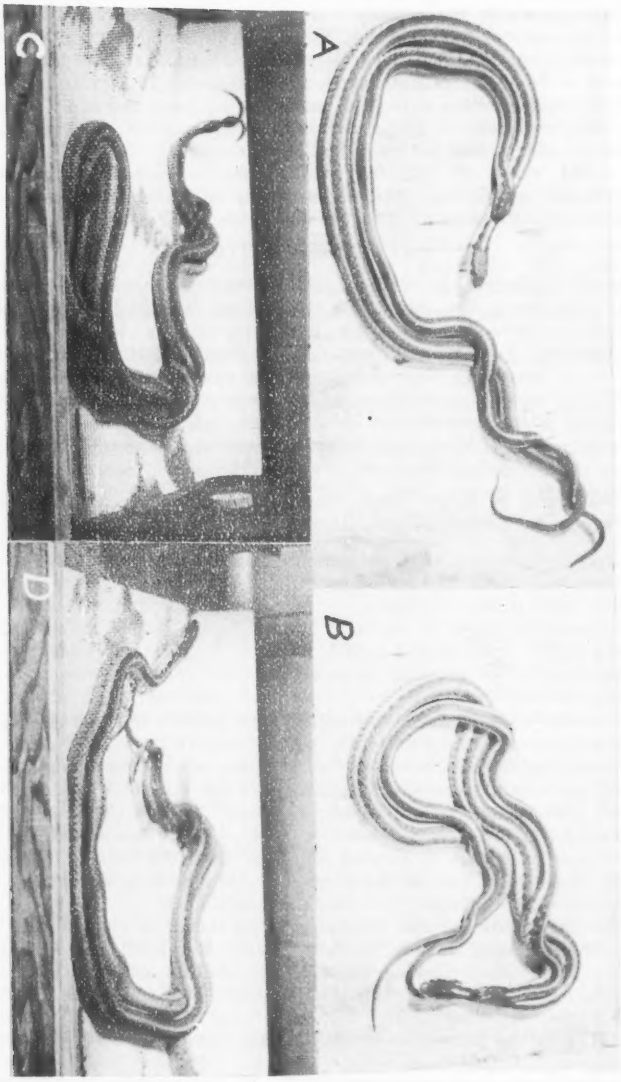


Fig. 1. Courtship attitudes of *Thamnophis sirtalis sirtalis* (Linn.)
Explanation in text.

room in which the snakes were kept was uncomfortably warm during much of June. During these 104 days of her captivity the female shed her skin once (May 15) and consumed 110 grams of food -- 83 grams of various frogs *(Pseudacris nigrita triseriata, Hyla crucifer, Rana sylvatica,* and *Rana pipiens)* and one 27 gram *Ambystoma tigrinum.* The eighteen young weighed 27 grams; the female after giving birth weighed 60.5 grams.

The writer is indebted to Dr. Paul S. Stokely, Assistant Professor of Zoology at the University of Notre Dame, for encouragement and for criticism of these notes.

## LITERATURE CITED

Davis, D. Dwight 1936 Courtship and mating behavior in snakes. Zool. Ser. Field Mus. Nat. Hist. 20 (22):257-290, figs. 28-34.

Blanchard, F. N. and Frieda C. Blanchard 1941 Factors determining time of birth in the garter snake *Thamnophis sirtalis sirtalis* (Linn.). Papers Michigan Acad. Sci. Arts, Letters, 26: 161-176, figs. 1-2.

---------- 1942 Mating of the garter snake *Thamnophis sirtalis sirtalis* (Linn.). id. 27: 215-234.

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A GIANT RED SALAMANDER FROM MARYLAND.--Dunn (The Salamanders of the Family Plethodontidae, 1926, p. 276) records as the largest specimens of *Pseudotriton ruber ruber* (Sonnini) a 146 mm. male from Hamilton County, Ohio (USNM 8818), and a 166 mm. female from Plummer's Island, D. C. (USNM 64014). Bishop (Handbook of Salamanders, 1943, p. 389) states that "this salamander attains an extreme length of about 6½ inches (165 mm) but this is much beyond the average." He also indicates that the females attain a larger size than the males.

A large male of this species was collected at the Children's Fresh Air Camp, Benson, Harford County, Maryland, at 9:30 a.m., July 31, 1948, swimming about in the shallow end of the camp pool. The preserved specimen measured 180 mm. total length, 75.5 mm. tail length, and 17.5 mm. head width. It is number A-2193 in the collection of the Natural History Society of Maryland.

Dr. Doris M. Cochran and Dr. E. R. Dunn kindly checked on the sex of the specimen.

--Jerry D. Hardy, Jr. and Yono Mork, Nat. Hist. Soc. of Md., Baltimore 28, Md.

# A NEW RECORD OF *SPEA BOMBIFRONS* FROM NORTHERN MEXICO AND REMARKS ON THE STATUS OF THE *HAMMONDII* GROUP OF SPADEFOOT ANURANS*

By I. Lester Firschein

Among the Mexican amphibians deposited at the American Museum of Natural History, New York, is a series of *Spea bombifrons* (Cope) from the State of Chihuahua, Mexico. These were brought to the author's attention in early June, 1949. The specimens (A.M.N.H. nos. 53576-53578, 53527) were collected by the Rockefeller Mexican Expedition at Samalayuca and vicinity on June 26, 1947, and are the first to be recorded, so far as known, from Mexico, extending the range-limit over five hundred miles (Wright and Wright, 1949, map, p. 114).

Two years after these specimens were obtained, on June 29, 1949, a party from the University of Illinois Museum of Natural History (Dr. and Mrs. Frederick A. Shannon, Dave Langebartel, and the author) visited this same locality and collected two specimens of this species: UIMNH No. 7842, twenty miles north, and No. 7843, nine miles south of Samalayuca, Chihuahua. These were found hopping about on wet pavement after the late afternoon and early evening showers that were the first rains to fall in the area since January.

One hundred and twenty-three specimens (UIMNH nos. 7844-7966) were also obtained on the southern outskirts of the city of Chihuahua the night of June 30, during a light rain. They were encountered at many roadside pools in company with *Scaphiopus couchii, Bufo cognatus, Bufo punctatus,* and *Microhyla olivacea. Spea bombifrons,* the smaller of the two spadefoots, were calling (short, distinct, bark-like notes, "crah-crah-rah") from the shallow marginal waters of the ponds. A few were found floating in deeper water and calling from this position. The *Scaphiopus couchii* were always seen in the deeper waters, and many floating pairs in amplexus were noted. No *Spea* were breeding when the collection was obtained at about 7:30 p.m.

Specimens UIMNH nos. 7842-3 are females measuring 55 mm. and filled with eggs. Of the large series from Chihuahua City only five are females, all with eggs and these range in size from 39.0 to 43.5 mm. The size range of the males was much greater, 38.0 to 47.5 mm.

In the light of the extended range of this species, the view expressed by Wright and Wright (1949) that *bombifrons* is a subspecies of *hammondii* seems untenable. Linsdale (1940) also believes that *hammondii* is subspecifically related to *bombifrons* because of the presence of "intermediate" populations. However,

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*Contribution from the Museum of Natural History, University of Illinois, Urbana, Illinois.

the well defined interorbital bony boss of *bombifrons* immediately distinguishes this species from any other *Spea*. Furthermore, the north-south range of *hammondii* is completely overlapped by that of *bombifrons* and it is thus quite apparent that *bombifrons* maintains its specific entity throughout this area without a sign of morphological intergradation. Bragg (1941A, 1944-1945) also considered that *bombifrons* is a distinct species.

In the course of a study of the *hammondii* complex of spadefoots, certain inconsistencies of the present-day knowledge of this group have come to light and should be mentioned in passing. Currently two species (other than *bombifrons*) of the *hammondii* complex are recorded from Mexico (Smith and Taylor, 1948): *Spea hammondii* (Baird) and *S. multiplicata* (Cope). Actually no incontrovertible records of the former species exist in the areas cited by Smith and Taylor (Chihuahua, Coahuila, Nuevo Leon, Tamaulipas, Sonora). Localities in Chihuahua, Coahuila, and Sonora are occupied by either typical *multiplicata* or specimens which appear to be intergrades between that form and *hammondii*. No literature citations or specimens have come to my attention to substantiate the presence of either form, or intergrades, from the states of Tamaulipas and Nuevo Leon. Bogert and Oliver (1945), anticipating the existence of the subspecific relationships between these two forms, list (without especial localities) "*Scaphiopus hammondii*" from Sonora. They regarded *multiplicatus*, the form actually referred to, as a subspecies without statement of that fact (as explained *in litteris* Bogert, 1949). The only exact locality known to the author from Sonora are two specimens (A.M.N.H. nos. 53018-53019) from Cananea, collected during July, 1946. These appear to be intergrades. Tanner (1939) in his review of the genus *Scaphiopus* evidently does not recognize *multiplicata* as either a full species or as a subspecies, mentioning only the single species, *hammondii*.

The allocation of *multiplicata* as a subspecies of *hammondii* would appear to be correct on the basis of adult characters.* The area of intergradation extends, probably, from New Mexico to Durango, Mexico. Specimens from this zone are difficult to assign definitely to either race, but a distinct north-south gradation may be delineated. This cline is especially evident in a number of diagnostic characters, *e.g.*, the ratio of the width/length of the metatarsal spade and the varying degrees of skin rugosity. Just how extensive the total area of intergradation may be, including regions north and south of the zone mentioned for "indeterminate" specimens, cannot as yet be ascertained. Clarification of this

*Taylor (1942) points out that marked differences exist between the tadpoles of *hammondii* (as described by Bragg, 1941B), and *multiplicata*, and that accordingly, these forms are not subspecies of each other. However the figure given by Taylor (Plate III, fig. 3) showing the larval mouthparts of *multiplicata* compares favorably with a larval *hammondii* from Calaveras County, California as pictured by Storer (1925, p. 39, fig. EE).

point awaits comparison of larger series of typical northern *hammondii* and the southern *multiplicata*.

The full generic rank of *Spea* is here tentatively accepted as applicable to the *hammondii* group of spadefoots. It must be pointed out that a more intensive study of the family *Scaphiopidae* will be necessary, however, to establish the generic value of such characters as the cuneiformity of the metatarsal spade and the extreme specialization of the frontoparietal bone. (A fontanelle is always present except in *intermontanus* in which it has become secondarily closed.)

I wish to express my sincere thanks to Mr. Charles M. Bogert, American Museum of Natural History, and to Dr. Hobart M. Smith, University of Illinois, for permission to examine specimens in their respective institutions, and for their interest and suggestions pertinent to this study.

## LITERATURE CITED

Bogert, Charles M. and Oliver, James A. 1945. A preliminary analysis of the herpetofauna of Sonora. Bull. Amer. Mus. Nat. Hist. 83 (6) 297-426, figs. 1-13, pls. 30-37, table 1, maps 1, 2.

Bragg, Arthur N. 1941A. Some observations on Amphibia at and near Las Vegas, New Mexico. Great Basin Nat. II (3): 109-117.

1941B. Tadpoles of *Scaphiopus bombifrons* and *Scaphiopus hammondii*. Wasmann Coll. 1 (3): 92-94.

1944-1945. Observations on the ecology and natural history of Anura. XII. The spadefoot toads in Oklahoma with a summary of our knowledge of the group. Amer. Nat. 78: 5-17; 79: 52-72.

Linsdale, Jean M. 1940. Amphibians and Reptiles in Nevada. Amer. Acad. Arts and Sci. 73 (8): 197-257.

Smith, Hobart M. and Taylor, Edward H. 1948. An annotated checklist and key to the amphibia of Mexico. U.S. Nat. Mus. Bull. No. 194: 1-118.

Storer, Tracy I. 1925. A synopsis of the Amphibia of California. Univ. California Publ. Zool. 27: 1-342, pls. 1-18, figs. 1-42.

Tanner, Vasco M. 1939. A study of the genus *Scaphiopus;* the spadefoot toads. Great Basin Nat. 1 (1): 1-34, pls. 1-6.

Taylor, Edward H. 1942 Tadpoles of Mexican anura. Univ. Kansas Sci. Bull., 28, pt. 1, No. 3:37-ss pls. 1-3.

Wright, Albert H. and Wright, Anna A. 1949 Handbook of frogs and toads of the United States and Canada. Comstock Publ. Co. Ithaca, N.Y. i-xii - 640, 124 pls. 37 maps.

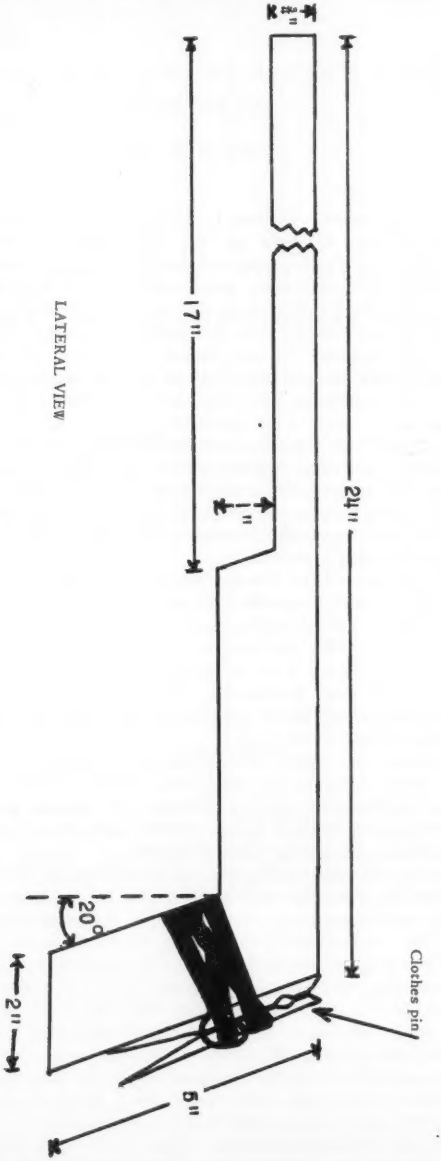
# AN IMPROVED METHOD FOR COLLECTING LIVING LIZARDS AND FROGS*

By Harold A. Dundee

Many collectors find that the capture of fast-moving lizards and frogs is an arduous task. Brown (Herpetologica, v. 3, 1946, p. 75) suggested the use of linked rubber bands which could be manually discharged as a missle for stunning lizards. While preparing such an apparatus I recalled a childhood method, one familiar to many of us, of discharging automobile inner tube bands from a wooden gun. Having utilized such a gun for the past summer I am convinced that it is a more rapid and accurate way of securing specimens than the method suggested by Brown. Its main improvement is the fact that it can be kept loaded and ready for instantaneous use. The method of Brown involves considerable strain on the hand as well as the use of both hands. A large gun 24 inches long and using 600 x 16 tube bands will stun *Crotaphytus* at distances up to 10 feet. Care should be taken to fire at the animal at nearly right angles to the surface on which it rests. Plans for the construction of a rubber gun are shown herewith.

The half of the clothes pin which is against the handle should be tacked on. The heavy inner tube binds the clothes pin tightly against the gun handle and provides the tension on the trigger. The gun is loaded by squeezing the clothes pin to spread its "jaws" and placing one end of a rubber band in the opening. The pressure is then released from the clothes pin thus pinning the band in place. The other end of the band is stretched out over the muzzle of the gun while the handle is held between the knees. Care should be taken to keep the muzzle pointed away from the face. Release of the band is accomplished by squeezing the clothes pin. An inner tube band, ¾ inch wide, with a single knot in the middle gives excellent results. By severing the end which is held in the clothes pin and using only one of the two strands thus obtained in the pin a band which stretches easily and has less hitting power may be made. This is more desirable for smaller animals. Live rubber, prewar tubes should be used, since postwar, butyl tubes have very little elasticity.

*Contribution from the Oklahoma Biological Survey and the University of Oklahoma Museum of Zoology.




Thickness of the gun should be between ¾ inch and 1 inch, depending on the size of the user's hand. ¾ inch is the most suitable size.

# NOTES ON A SPECIMEN OF *SCELOPORUS POINSETTII* AND ITS YOUNG

By Ralph W. Axtell

On the afternoon of May 1, 1949, a large female *Sceloporus poinsettii* was collected on the Schreiner Ranch, located in Kimble County, Texas, approximately 23 miles south southwest of Junction. The specimen was found under a medium sized slab of limestone which rested near the edge of a fifty-foot cliff formed by a spring fed tributary to the South Llano River. The lizard upon being exposed did not leave the bottom of the rock, but darted back and forth in an effort to escape my hand. After some difficulty the specimen was captured and placed in my collecting bag.

The female is typical, having a dorsal scale count of 37; supraoculars in two complete rows; 12 femoral pores; 12 dark bands on the tail; and 5 dark bands on the back. The nuchal collar is 4 black scales wide, bordered by a light band 2 scales wide. The specimen possesses light blue lateral belly patches characteristic of the males.

Measurements of the female appear in Table I below.

The lizard was kept alive in my private collection, where it fed on crickets, grasshoppers, and termites.

On June 7, 1949, the female *poinsettii* gave birth to eleven living young. There was no observation of the birth. By the time the event was discovered, all of the young were dry and actively scampering about the cage. No remnants of fetal membranes were found in the cage.

Dr. Hobart M. Smith (Handbook of Lizards, p. 198), gives 2½ to 3 scale lengths as the black nuchal collar width of this species. In the present specimens, the female and her young (4 counted), the nuchal collar width was from 4 to 5 scales. Other than this the young all are typical.

There is no sexual dimorphism exhibited in the color of the young, but in size, the males seem to be slightly smaller. , In color and markings, however, the young differ somewhat from the adult. The coloration of the young is much more distinct than that of the adult, although their overall coloration is lighter. The markings of the juveniles are also more distinct; the black bands on the middle of the back number slightly more (6-7) than the average (4-5), and the black bands on the tail vary from 10 to 12. The gular area of the young is distinctly marked with grey or black irregular lines running transversly to the middle of the throat, where they are intercepted by a median pair of longitudinal lines enclosing a narrow light line. These lines do not continue past the gular region. The chest and belly of all the young specimens are immaculate. Measurements of the juveniles were taken three days after birth.

| Lengths in mm. | Female | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex | | ♂ | ♀ | ♀ | ♀ | ♂ | ♀ | ♀ | ♀ | ♂ | ♂ | ♂ |
| Snout-vent | 111 | 32 | 33 | 34 | 33 | 33 | 34 | 34 | 34 | 33 | 33 | 33 |
| Tail | 149 | 20- | 39 | 42 | 40 | 40 | 41 | 42 | 42 | 41 | 40 | 39 |
| Total | 260 | 52- | 72 | 76 | 73 | 73 | 75 | 76 | 76 | 74 | 73 | 72 |
| Head Length | 27 | 10 | 9 | 10 | 9 | 10 | 9 | 10 | 10 | 10 | 10 | 10 |
| Head Width | 26 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| Lgth. of foreleg | 44 | 16 | 16 | 15 | 15 | 15 | 15 | 15 | 16 | 14 | 15 | 15 |
| Lgth. of hindleg | 71 | 22 | 22 | 21 | 22 | 22 | 22 | 23 | 23 | 20 | 21 | 23 |
| Axilla-groin | 56 | 19 | 18 | 18 | 19 | 19 | 19 | 19 | 20 | 19 | 18 | 18 |

**Measurements of a Female *Sceloporus poinsettii* and Her Brood**

The young specimens were very active, and fed greedily on houseflies and termites.

One young individual was released on a wood pile in my back yard, where it lived until winter. The lizard was not recaptured and measured, but when it was observed sunning on top of the pile November 26, 1949, it appeared to be at least one-half the size of its mother. Natural growth should have been nearly normal in this semi-natural free environment. When the lizard did not show up this spring (1950), the wood pile was moved in an effort to find it, but nothing was discovered.

--Texas College of Arts and Industries, Kingsville, Texas

## A CASE OF DUPLICATION OF THE TAIL IN PLETHODON

W. Gardner Lynn

Doubling of the tail is rather frequently encountered in lizards but only a few records of this abnormality in amphibians are known to the writer. On July 2, 1947 an adult specimen of the salamander *Plethodon cinereus cinereus* (Green) showing this condition was collected in a wooded area near Woods Hole, Mass. Because of the seeming rarity of such cases this seems worthy of record.

It will be seen from the photograph that the supernumerary tail in this individual appears as a branch coming off the dorsal side of the normal one. The specimen is one showing a clear-cut dorsal band of red and this band continues onto the dorsal surface of the supernumerary tail, the normal tail showing no dorsal band. The total length of the salamander is 53 mm. The normal tail is 19 mm. in length; the secondary tail measures 13 mm. and is attached to the primary one 3 mm. behind the cloaca. Since the extra tail lies directly dorsal to the primary one and is parallel to it the two are difficult to distinguish when viewed from above.

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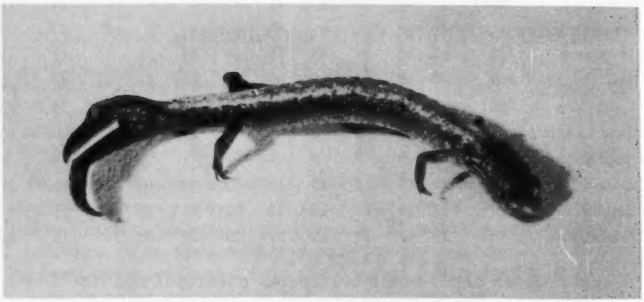

Photograph of the specimen after preservation. The two tails have been separated by a strip of paper to make them easily distinguishable.

The usual explanation which is advanced to account for such anomalies is that the doubling arises as a result of regeneration from an irregular cut surface. This has been experimentally demonstrated as a method for producing supernumerary tails and limbs in amphibians (Tornier 1897, 1905; Barfurth 1898, 1899; Dawson 1932) and Przibram (1909) considers that all cases of naturally occurring reduplicated appendages are the result of regeneration following a ragged amputation. In some specimens there are visible scars indicating that some such injury has occurred but this is not so in the present case. The primary tail seems to be of about normal length and shows no scar at the point of union with the secondary tail. It is possible that in this instance the extra tail has resulted from regeneration from a lesion on the dorsal surface of the normal tail, the latter thus remaining intact. Barfurth's experiments showed that secondary tails are sometimes formed following such lesions. If this were the case however one would expect that the dorsal pigment band would be found on both tails. The fact that it is absent on the primary tail may indicate that the doubling occurred during early development before the pigment pattern had been established. Since, in Plethodon, the pigment pattern is well defined even before hatching the anomaly would then be regarded as a developmental abnormality rather than as a result of injury.

A brief survey of the literature has revealed only six definite records of naturally occurring tail duplication in salamanders. Przibram (1909) gives a figure illustrating a case in *Proteus anguineus* which had apparently been previously recorded by Kammerer. Blatchley (1906) records a two-tailed specimen of *Plethodon cinereus* from Indiana. This animal was 38 mm. long and the tail is described as being forked at a point near the middle, forming two prongs separated by about a 30° angle. The tail was only 12 mm. long, the left fork measuring 7 mm. and the

right 5 mm. There are four papers which contain reports of tail duplication in *Triturus viridescens*. Two of these (Collins 1932, Porter 1934) concern specimens from the same locality, Seaton's Lake near Uniontown, Pennsylvania, and it seems possible that they refer to the same specimen. Collins merely records "a male with an irregularly bifid tail" but Porter gives a much fuller description. The supernumerary tail was 20 mm. long and joined the normal tail 10 mm. behind the cloaca. The duplicate tail is described as lying on the right ventro-lateral surface of the primary one and projecting ventro-caudally so as to make an angle of about 45° with it. The normal tail extended 22.5 mm. beyond the attachment. Porter states that this is not a case of bifurcation of the normal tail but that the extra appendage is a branch springing from the right side of the primary one. Indeed it is noteworthy that none of the recorded instances of tail duplication in salamanders can be considered as true cases of cauda bifida in the strict sense. Porter considers that, in his specimen, there is evidence that the abnormality arose through regeneration since neither tail is as long as that of a normal animal. Smith (1913) describes and figures a specimen of *Triturus (Diemyctelus) viridescens* from a pond near Ann Arbor, Michigan which had the tail branched near the posterior end. Sections showed that each branch had well-formed vertebrae and a spinal cord. Dawson (1932) records a male Triturus from Northampton, Massachusetts which, judging from the figures, had a condition closely resembling that seen in Smith's specimen. Dawson concluded, from a detailed study of sections of the tail, that it would probably be necessary to postulate two successive injuries followed by regeneration in order to account for the conditions found. Having formulated this hypothesis he proceeded to test it experimentally. In a number of cases he was able to produce duplication of this same type by first removing the tip of the tail by an oblique cut, allowing regeneration to proceed for some weeks, and then making a second wound which removed the dorsal part of the tail up to a level proximal to the original cut.

## LITERATURE CITED

Barfurth, D. 1898 Die experimentelle Herstellung der Cauda bifida bei den Amphibien. Verhl. der Anat. Gesellschaft. 12: 24-46.

---------- 1899 Die experimentelle Herstellung der Cauda bifida bei den Amphibienlarven. Arch. f. Entwm. 9: 1-26.

Blatchley, W. S. 1906 On some reptilian freaks from Indiana. Proc. Acad. Nat. Sci. Phila. 58: 419-422.

Collins, H. H. 1932 Morphological anomalies in the amphibian Triturus viridescens. Proc. Penn. Acad. Sci. 6: 165-167.

Dawson, A. B. 1932 A ventral accessory tail in Triturus viridescens and its duplication experimentally. Anat. Rec. 52: 139-149.

Porter, H. C. 1934 A case of nearly perfect cauda bifida in Triturus viridescens. Proc. W. Va. Acad. Sci. 7: 37-38.

Przibram, H. 1909 Experimental-Zoologie 2. Regeneration. Leipzig. 388 pp.

Smith, B. G. 1913 An adult Diemyctylus viridescens with bifurcated tail. Fifteenth Report Mich. Acad. Sci. 1913: 105.

Tornier, G. 1897 Uber experimentelle erzeugte dreischwanzige Eidechsen und Doppelgliedmassen von Molchen. Zool. Anz. 20: 356-362.

---------- 1905 An Knoblauchskroten experimentelle entstandene uberzahlige Hintergliedmassen. Arch. f. Entwm. 20: 76-125.

--The Catholic University of America

## VERTICAL ORIENTATION OF THE EYE IN SNAKES

By D. F. Munro

Study of the eye-movement in non-crotaline snakes concurrently with and subsequent to the observations resulting in a note on the maintenance of verticality by the elliptical pupil of the Copperhead (Herpetologica, v. 5:106), cast doubt on the plausibility of the surmise that this ability was an accommodation necessary for accurate striking by the pit vipers.

In the snakes examined, both those with elliptical pupil *(Agkistrodon, Crotalus, Sistrurus, Constrictor)* and those with round pupil *(Thamnophis, Coluber, Pituophis, Heterodon, Elaphe),* it was found without exception that the eye tends to keep its original normal or average position while the head is being tilted in the longitudinal vertical plane.

Besides this rotation of the eye about its horizontal pupillary axis, there is also a tendency of the eye to "remain level" when the head is tilted laterally out of the vertical. For lateral tilts such as snakes execute when cautiously investigating a piece of food offered them, the eye is seen to remain horizontal by rotating in its socket in a direction opposed to the tilt of the head. The eye is able to maintain its horizontal orientation only for small lateral tilts, and further lateral twisting pulls the eye along with the head.

In general, it is not easy to detect the movement of the round-pupilled eye upon longitudinal tilting of the head, because the iris does not usually display sufficiently clear distinguishing marks to betray the extent of the eye's stability upon movement of the head. By steadily watching as the head tilts, one can see the adjustment being made by the eye, but ordinarily not with sufficient accuracy to gauge its amplitude. In such cases, photography does not afford a record of the phenomenon because of

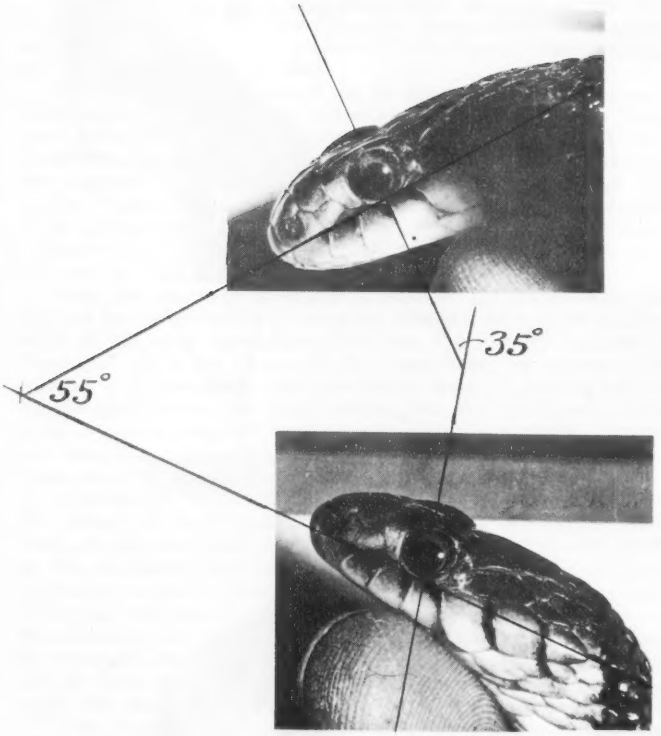


Figure 1, *Thamnophis ordinatus parietalis.*

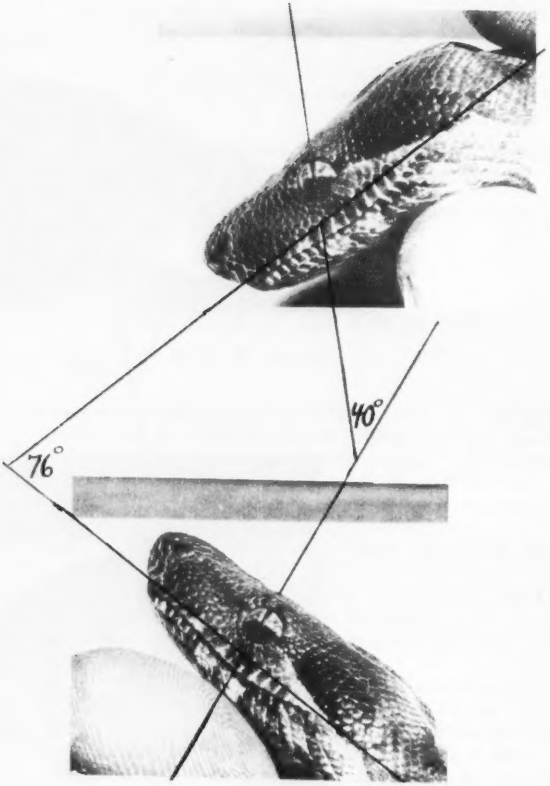


Figure 2, *Constrictor c. constrictor*

Photographs by D. W. Quackenbush

lack of reference points in the eye itself, even when the pupil is strongly contracted in bright light, thus emphasizing the iris area.

Snakes of the same species differ considerably with regard to minor markings in the iris, and it is possible to select an occasional individual which has some dark or light spots conspicuous enough for determining a reference for the exact vertical axis. Of all the specimens examined, a large female *Thamnophis ordinatus parietalis* with fairly pronounced markings in the iris appeared to be the most promising for photography. The snake was held loose in the hand in front of a horizontal reference line and photographed when relaxed.

Figure 1 reproduces two of the pictures made in this manner, mounted to show the relative motions of head and eye. The lines were drawn as follows: the reference line for the position of the head, from the juncture of the first upper labial with the nasal to the posterior tip of the last upper labial; the eye-line, through the center of the pupil and a small dot in the iris which shows clearly in the photographs. It is clear from the diagram that the eye does not move in unison with the head when the latter tilts vertically, but that it lags some 20° behind in a head-movement of 55°.

From the series of photographs taken of the Garter Snake, it can not be determined with certainty whether there is an angular shift of the head throughout which the eye remains constantly "vertical" (as is the case with the Copperhead, for instance), or whether it rather merely tends to remain vertical, lagging behind as the head moves, and thus rotating less than the head. However, a narrow range of constant verticality is probable. As in the case of the Copperhead, the eye of the Garter Snake compensates more for upward than for downward tilt of the head.

A terrestrial snake has little occasion to look down--it is on the ground and there is no food or enemy below it. On the other hand, an arboreal snake may look down part of the time. To check on the conjecture that the arboreal snake might therefore have developed a greater accommodation of the eye in the downward direction, a series of photographs was made of a three-foot male boa, *Constrictor c. constrictor* (which came to Kansas in a carload of bananas); two of the pictures make up Figure 2. The head-line is from the front to rear corner of the mouth; the eye-line, along the axis of the elliptical pupil. With a head-movement of 76°, the eye shifts only 40°. The diagram shows thus that the elliptical pupil has a greater ability to remain vertical than the round one, at least for the snakes examined, and also that the accommodation for downward tilt is greater than for upward.

Movement of the eye to counteract vertical tilts of the head is apparently a common feature of the optical organ of all snakes. To judge from observation of the kinds of serpents listed above, round-pupilled eyes do not have as great a tendency to remain vertical as do the elliptical, and presumably the difference is associated in some way with the peculiarities of the visual aperture, rather than with the phylogenetic relationships of the creatures.

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ADDITIONAL OBSERVATIONS ON HEAD-BOBBING BY SNAKES: In his account of the habit of head-bobbing by snakes, Neill (Herpetologica 5, 114f.) remarks that it is a general characteristic of male and female snakes, apparently connected with the sex life and recognition of individuals. The following notes may bear out this view.

The habit of bobbing in the presence of other individuals of identical or different species, or genera, has been observed in the following snakes not mentioned by Neill: *Thamnophis ordinatus parietalis, Pituophis catenifer sayi, Coluber constrictor flaviventris,* and *Agkistrodon contortrix mokasen.* However, it has not been noticed in specimens less than a couple of years old; this suggests that it is indeed an activity associated with the maturation of the individual.

Two snakes in particular of the writer's small collection, a large female *Thamnophis o. parietalis* and a five-foot male *Pituophis c. sayi,* almost invariably bob the head when stroked gently with the finger-tip on the head and neck in the manner of petting a cat. The bobbing is a vigorous movement, executed in a vertical plane, the head rotating on a horizontal axis at right angles to its longitudinal axis, and is quite similar to a jerky nodding of the head by a person who tucks the chin "into the neck" rapidly at each nod. These two snakes often accompany the bobbing with a fairly energetic arching of the neck, as if to thrust the finger away. Head-bobbing under such artificial circumstances had seemed to be a sign of annoyance, especially in the case of the Bull Snake, an exceptionally timid specimen, which usually sought to crawl away from such treatment after arching the neck. The neck-arching has not been observed when snakes meet each other, nor do the snakes appear to withdraw from or avoid each other upon bobbing.

Two four-year-old Copperheads, a male and a female, never have responded to experimental petting by bobbing; instead, they flatten the head and neck, and ordinarily move out laterally from under the finger, but without any show of hostility. When put into one cage after being separated for some days, they both bob upon encountering each other, though the male does so more vigorously. After being together for weeks in the same cage, they occasionally are seen to start bobbing, for no apparent reason. Factors of illumination and outside disturbance do not seem to be involved.

Many times the bobbing by snakes is not confined to the head and neck, but the effect extends farther down the body and becomes rather violent; it includes then at least the anterior half of the serpent. With each convulsive downward movement of the snout, the dorsal portion of the body jerks forward as the ventral moves backward; it is as if the lower ends of the ribs first stretch backward, then forward, so that the back and belly carry out an oscillating or reciprocating motion. In the case of the male Copperhead during courtship (when the bobbing becomes very agitated), the tail and posterior part of the body execute lateral wriggling and writhing movements, not noticeably coordinated with the bobbing of the head.

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# HERPETOLOGICAL NOTES AND RECORDS FROM COLORADO

By T. Paul Maslin

During the past several years the size of the herpetological collections of the University of Colorado Museum has increased considerably. This collecting activity has disclosed several new records for the state and has added to our knowledge of the ranges of some of the less common forms. I wish to herewith acknowledge the financial assistance rendered me by the University of Colorado Council on Research and Creative Work which has made this recent extensive collecting possible. The following accounts of various species are based on specimens in the University of Colorado Museum.

*Rana catesbeiana* Shaw

Ellis and Henderson (1915) reported that this bullfrog had been introduced into several ponds and reservoirs in the upper South Platte River valley. As far as I am aware these seedings have failed, although as recently as 1948, a population existed within the city limits of West Denver in a small pond which has since been drained. The frog is well established however, in the vicinity of Wray, Yuma County, in the Cimarron River drainage of Baca County, and in the Arkansas River valley as far west as Pueblo; but it is nowhere common except in the vicinity of Wray.

*Crotaphytus collaris baileyi* Stejneger

On May 20 and 21, 1948, at a point 5 miles south of Fruita, Mesa County, 18 specimens of this species were collected. Then on June 28, 1949, four more were collected at a point 12 miles north of Rifle, Garfield County, and two days later two more at a point about five miles east of Carbonera, on the Douglas Pass Road in the same county. These records definitely establish the presence of this lizard in the Colorado River valley in Colorado. It is interesting to note that the first record of this species in the state was made by Cockerell (1910), who recorded one specimen from Rifle Gap, Garfield County. This station is close to the site 12 miles north of Rifle mentioned above but still remains the most northerly and easterly record of the species in Colorado.

*Gambelia wislizenii wislizenii* (Baird and Girard)

Previously this species has been recorded from Colorado solely on the basis of a single specimen collected south of the San Juan River in the extreme southwestern corner of the state by Barry (1933). On June 15, 1949, two more specimens were collected from identically the same place. These two specimens, both females, measure 93 and 107 mm. respectively from snout to vent. The dorsal surfaces are evenly but irregularly covered with round, brown spots, each of which diffuses through lighter browns into the gray ground color. The largest spots are about 2.5 mm. in diameter, with from 3 to 6 mm. between spots. The gray ground color is irregularly broken up into roughly quadrangu-

lar areas by lighter bands. The ventral surface of the tail is a deep rose, almost cardinal red; and extending up the sides of the body are broken bands about 4 mm. wide of the same color. These bands do not meet at the mid-dorsal line but are nevertheless paired.

Another specimen was collected in a small sandy patch 7 miles SSE of Fruita, Mesa County, on May 22, 1948. This specimen, a male, measures 118 mm. from snout to vent. This is an extension of the known range in Colorado by 140 miles to the north, and establishes the presence of this species in the Colorado River valley in Colorado. In this specimen the round, brown spots are slightly larger and fewer in number and the deep rose color of the ventral tail surface and flanks is lacking.

*Eumeces multivirgatus* (Hallowell)

This small skink has hitherto been known in Colorado from the flat eastern prairies only. On May 29, 1949, a specimen was collected near the Great Sand Dunes National Monument headquarters in Alamoso County, and three days later another specimen was collected just north of San Luis, Costilla County. These records extend the range of this species into the San Luis Valley. This is of particular interest in view of the altitude of these stations which are both 8,000 feet above sea level. No other lizards occur in the area except *Phrynosoma douglassii ornatissimum* (Girard) and *Sceloporus undulatus tristichus* Cope. These two specimens donot differ morphologically from the plains form but the habitat from which they were collected is distinctly different. The plains form inhabits sandy areas and is particularly common in the sand hills of the South Platte drainage. The San Luis Valley specimens were both found in rocky areas between large boulders. The sand areas nearby were searched, but apparently are unoccupied. It seems likely on geographical and ecological grounds that the San Luis Valley population is a tongue of the New Mexico-Arizona population with which it may be continuous.

*Cnemidophorus tesselatus* (Say)

Smith and Burger (1949) recently have pointed out that the type locality of *Cnemidophorus tesselatus* (Say) lies to the east of the Rocky Mountains and shrewdly assumed that the name *C. grahamii* Baird and Girard was a synonym of *C. tesselatus* and the species which had until recently borne the name *C. grahamii* is Say's species *C. tesselatus*. As far as Smith and Burger knew at the time no *Cnemidophorus* of this complex had been taken in Colorado since the type was collected by James on July 19, 1820. Actually, however, Colorado material was available and since their publication more material has been collected. The museum now has specimens from the following localities:- *Pueblo County:* near Pueblo; foothills Greenhorn Range, west of Pueblo; foothills near Rye; foothills east of Rye. *Otero County:* 6 mi. NE Higbee; 1 mi. S Higbee Store. *Las Animas County:* Purgatoire River 19 mi. E Model; Cottonwood Creek, 4,600 feet. *Baca County:*

27 mi. S Pritchet. This material indicates that Smith and Burger's *(loc. cit.)* reasoning is correct and that the name *C. grahamii* should be considered a synonym of *C. tesselatus.*

The color pattern of medium to large specimens consists of seven fairly well defined narrow light stripes on a black field. The intervening dark stripes between the paravertebral light stripe and the two light stripes below it are broken into quadrangular, black patches by transverse light marks joining the light longitudinal stripes. This disruption of the dark stripes into distinct rectangular marks is more complete posteriorly than anteriorly. The paravertebral dark stripes are separated by a median undulating light stripe which may be broad enough to break up the dark stripes into longitudinal series of dark spots which alternate with each other. The belly scales are white, but the intervening skin is black. Laterally the black pigment encroaches onto the antero-median edges of the scales and the same effect is found on the pectoral scales. The tail is usually unstriped but dorsally is irregularly spotted with black on its anterior third.

The juvenile pattern consists of seven distinct light stripes intervening between eight black stripes. The vertebral stripe is strongly undulant and gives this juvenile pattern a striking effect which is quite diagnostic of this species. The light stripes extend onto the tail for a third of its length. The belly scales are unmarked. In one juvenile, however, measuring 40 mm. from snout to vent, the smallest specimen in our collections, the undulant vertebral stripe is lacking between the shoulders, and posterior to this consists of irregular light spots which form an undulant line only for a short distance anterior to the level of the hind legs.

The scales on the posterior surface of the forearm are only slightly enlarged, not even as much so as the comparable scales of *C. sexlineatus.* A double gular fold is present, and the first row of scales anteriorly margining the primary gular fold are distinctly enlarged. Occasionally the second row is somewhat enlarged as well.

*Cnemidophorus perplexus* Baird and Girard

Smith (1946) has allocated the lizards of the *sexlineatus* group which occur in southwestern Colorado to the subspecies *Cnemidophorus gularis octolineatus* Baird. The University of Colorado Museum now has adequate series of this lizard from that area and it appears, from a study of these series, that this form is actually *Cnemidophorus perplexus* Baird and Girard. The color pattern of juveniles and adults is essentially the same except that the colors in juveniles are more brilliant. The pattern consists of six narrow, vivid white stripes plus a faint and diffuse median stripe. The color between these stripes is nearly black and shows no trace of light spots. In juveniles a distinct white stripe is present on the tail below the continuation of the dorsolateral stripe of the trunk. This stripe extends anteriorly onto the thigh and is subtended by a diffuse dark stripe. In adults this light and dark

stripe combination is obscure and the back of the thigh is generally mottled. The tail of juveniles is a bright slate blue in life, but in adults this fades to a dull slate color. The ventrum is white with a faint suffusion of blue. The largest specimen on hand, a female with four eggs, measures 87 mm. from snout to vent; most specimens however, are about 10 mm. shorter. The pattern in this specimen does not differ from the norm.

In some scale characters these lizards approach typical *C.g. octolineatus*. In ten specimens selected at random there were 68 to 77 rows of dorsal scales at the poir of greatest girth and 6 to 9 scales between the paravertebral light stripes. The scales bordering the edge of the primary gular fold are enlarged and intergrade by a single irregular row of smaller scales with the minute scales within the gular furrow. The antebrachial scales of the forearm are definitely enlarged and are about 5 to 7 times as large as the smallest scales dorsal to them. The femoral pores vary from 16 to 18 in the ten specimens examined. From these counts it can be seen that these lizards approach *C.g. octolineatus* ♀ defined by Smith *(lit. cit.)* in the character pertaining to the number of scales between the paravertebral light stripes. In other mensurable characters they are more like *Cnemidophorus perplexus*.

*Diadophis punctatus arnyi* Kennicott

One specimen of this snake was collected in the vicinity of Kim, Las Animas County on Sept. 15, 1949, by Edward Lujon of that city. This constitutes the third record of this snake for Colorado. The specimen measures 202•51 mm. in length; there are 155 ventrals and 48 pairs of subcaudals; the scale row formula is 17-17-15. The orange neck ring, interrupted dorso-medially, is two scale lengths wide and two scale lengths from the parietals, and is narrowly margined with black both anteriorly and posteriorly. The ventrum is copiously and irregularly spotted with black.

*Rhinocheilus lecontei tesselatus* Garman

In the summer of 1948 a specimen was acquired from Eugene Main, of Lamar, Prowers County. Mr. Main entertains a clientele of truck-driving friends by identifying reptiles picked up by them on the highway. This specimen was acquired by Mr. Main from one of these drivers. As there was a possibility that the snake had been collected in Kansas and brought to Mr. Main as a joke the record was not published. On Aug. 31, 1949, however, Dr. W. A. Weber of the University of Colorado collected an additional specimen on the south side of the Cimarron River in the extreme southeastern corner of Baca County. This establishes the occurrence of this species with certainty in the state. These specimens fit Klauber's (1941) re-description of the subspecies in all particulars except that the snout is not tilted upwards to the extremes described by him. There is a distinct concavity between the rostral and the internasals but the highest anterior point of the rostral does not lie above the level of the highest points of the internasals. These specimens, both males, measure 638 and 498 mm. respectively, of which the tails constitute .15

and .18 of the total length. The scale counts are as follows: ventrals 199,197; anal undivided; subcaudals 52,56, of which 10 and 21 terminal ones only are paired; supralabials 9-8, 8-8, infralabials 10-9, 9-9; dark dorsal body blotches 35,38, these being 1.25 and 1.50 as wide as the interspaces; tail blotches 12,14. The lateral reversion of the color pattern is so extensive in the larger specimen that the black pigment in the lateral interspaces forms a distinct series of large lateral blotches which are fused to the smaller spots of the ventrolateral series.

From the distribution of this subspecies in southwestern Kansas and northeastern New Mexico it is not surprising to find the form in Colorado and it is also to be expected that the species would not be common here.

*Thamnophis eques cyrtopsis* (Kennicott)

On Aug. 21, 1947, a small specimen of this snake was collected in Carrizo Creek, near Troy, Las Animas County. As all of the species of *Thamnophis* which occur in this area are peripheral in their respective ranges and all show varying degrees of divergence from more typical examples of each species this specimen was tentatively identified as *Thamnophis radix haydenii* Kennicott until more material could be acquired. Subsequently the general area was visited several times but it was not until Aug. 8, 1948, that another example of this species was collected, at Cottonwood Creek, 4,600 feet, Las Animas County, a site a few miles farther west. Enough material is now on hand to make it possible to definitely differentiate these specimens from the juveniles of the other species in the area. These specimens, a male and a female, measure 289 and 370 mm. respectively of which .22 and .20 is tail; the scale row formula is 19-19-17; ventrals 174,172; subcaudals 80,67; supralabials 8-8,8-8; infralabials 11-10, 10-10; preoculars 1-1. The nuchal crescents are large, intensely black and distinct, measuring about 4.5 scale lengths in breadth. The two crescents touch each other just posterior to the interparietal suture. The vertebral stripe is narrow, occupying the vertebral row and about a third of the adjacent rows on either side. The alternating spots of the two dorsal-lateral rows are distinct anteriorly but hardly distinguishable posteriorly, especially in the female whose pattern in this area consists of three brightly distinct stripes on a brown background. These specimens definitely establish the presence of this species in the extreme southwestern part of the state.

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*Tropidoclonion lineatum* (Hallowell)

On Aug. 27, 1947, Mr. Stanley Gale, a highschool student in Denver, collected a specimen of this species within the limits of that city. A few days after capture this specimen gave birth to three young, two males and a female, which measured 87•17, 94•19, and 94•17 respectively; the parent snake measured 241•28 mm. On April 21, 1948, members of the Museum staff collected three more specimens from the same locality and on April 30, 1949, three more specimens were collected there. It was obvious

that a permanent colony was established at this site in Denver, but it was uncertain as to whether this colony represented a clone derived from escaped pets or was a natural population. On Sept. 15, 1949, four more specimens were collected 6 miles NE of Higbee, Otero County. This last collection definitely establishes the presence of this species in Colorado.

This Colorado material does not differ from other populations of the species to the east; ventrals 8♂, 135-144, m. 139.8; 6♀, 136-150, m. 141.1; subcaudals 8♂, 40-46, m. 41.5; 5♀,32-36, m. 34.0; ratio of tail to total length 8♂, .16-.17, m. .165; 5♀, .10-.15, m. .130; scale rows 17-19-17 (19 on neck in two specimens); supralabials 6-6 (5-6 in two specimens); infralabials 6-6 (5-6 in two specimens); preoculars 1-1; postoculars 2-2; temporals in two rows, but only the first temporal of the upper row touches the postoculars.

*Sistrurus catenatus tergeminus* (Say)

Evidence for the occurrence of this species in Colorado previously has been based on Ellis and Henderson's (1913) record of a single specimen collected by A. E. Beardsley in Baca County. During the last five years this area has been searched for this species on several occasions but so far without success. There is, however, an island population one hundred miles to the northwest in the vicinity of Arlington, Kiowa County. Through the kindness of Mrs. Lamberson of that area and Mr. William Horstman of Pueblo, five males and one female of this population have been acquired by the Museum. The males show a remarkable uniformity in scale counts, but the scale row formula is somewhat variable. The counts and measurements of the males of this series are as follows: length 281-462 mm. of which the tail constitutes .11-.12 of the total lengths respectively, m. .116; ventrals 143-148, m. 144.8; subcaudals (unpaired except last 1 or 2) 28-30, m. 29.0; supralabials (ten counts) 11-13, m. 12.1; infralabials (ten counts) 12-13, m. 12.6; preoculars 2-2; postoculars 3-3; suboculars 1-1; scale rows 23(25)-23(25)-19, dorsal body blotches 34-41, m. 37.8; dorsal tail blotches 7-9, m. 8.0. The female measures 347 mm. in total length of which the tail is .09; ventrals 142; subcaudals 23; supralabials 11-11; infralabials 12-12; preoculars 2-2; postoculars 3-3; suboculars 1-1; scale rows 21-23-19; dorsal body blotches 35, dorsal tail blotches 7.

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This population constitutes a considerable extension of the known range of this species in Colorado.

*Kinosternon flavescens flavescens* (Agassiz)

This species previously has been reported for the state by Ellis and Henderson (1913) who published records of its occurrence at Lamar, Prowers County, and in Baca County. On July 10, 1948, a large series was collected in the vicinity of Wray, Yuma County. While this constitutes an extension of the known range in Colorado by a distance of 135 miles to the north the species does occur close by in Nebraska.

The specimens from Wray were collected from the North Fork of the Republican River or in ponds nearby. Frequently indi-

viduals were caught in the sodden vegetation at the water's edge or in cattle tracks in the marshy areas near water but no specimens were actually collected on dry land. Correlated with this close association with water is an interesting symbiotic relationship similar to that observed in *Sternotherus odoratus*. All the specimens collected were heavily encrusted with a filamentous green alga which often made them extremely difficult to recognize in the field. Most of this vegetation has worn off as a result of our collecting methods, but patches can still be seen in the angles beneath the carapace. Freshly captured specimens would exude huge quantities of a dark yellowish brown oil which presumably gives the turtles their unpleasant odor and certainly makes them unpleasant to handle.

## LITERATURE CITED

Barry, L. T. 1933 Notes on Colorado reptiles. Copeia, 1933 (2):99-100.

Cockerell, T. D. A. 1910 Reptiles and amphibians of the University of Colorado Expedition of 1909. Univ. of Colo. Stud. 7:130-131.

Ellis, M. M. and J. Henderson 1913 The Amphibia and Reptilia of Colorado, Part I., Univ. of Colo. Stud. 10:39-129, 8 pl. (40f).

1915 Amphibia and Reptilia of Colorado, Part II., Univ. of Colo. Stud. 11:253-263, 2 pl. (9f).

Klauber, L. M. 1941 The long-nosed snakes of the genus *Rhinocheilus*. Trans. San Diego Soc. Nat. Hist., 9(29): 289-332, pls. 12-13.

Smith, H. M. 1946 Handbook of lizards. Comstock Pub. Co., Ithaca, New York, xxi-557 pp., 135 pl., 136 f., 41 maps.

Smith H. M. and W. L. Burger 1949 The identity of *Ameiva tesselata* Say. Bull. Chicago Acad. Sci., 8:277-284.

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## THE VERTICAL POSITION OF THE PUPIL IN CROCODILIANS AND SNAKES

By E. Ross Allen and Wilfred T. Neill

In a recent paper, Munro called attention to the interesting fact that the pupil of the eye, in some crotalid snakes, tends to remain in a vertical position regardless of the movement of the head (Herpetologica 5, no. 5, special: 106). Munro's observations related to the northern copperhead and the western pygmy rattler; we wish to present similar data for certain colubrid, boid, and crotalid snakes, and for crocodilians.

An examination was made of all the reptiles currently on display at the Ross Allen Reptile Institute. This examination revealed that the ability to maintain a vertical pupil is present in a remarkably diverse group of species.

It was found that in the common boa *(Constrictor c. constrictor)*, the imperial boa *(C. c. imperator)*, the Cuban boa *(Epicrates angulifer)*, the rainbow boa *(E. cenchris)*, the reticulated python *(Python reticulatus)*, and the rock python *(P. sebae)*, the pupil tended to remain vertical while the head was tilted through an angle of at least 65°. A similar situation was noted in the southern copperhead *(Agkistrodon c. contortrix)*, the cottonmouth moccasin *(A. p. piscivorus)*, the Florida pygmy rattler *(Sistrurus miliarius barbouri)*, the prairie rattler *(Crotalus v. viridis)*, the canebrake rattler *(C. horridus atricaudatus)*, and the diamondback rattler *(C. adamanteus)*.

Studies were made on a large series of living *Tretanorhinus v. variabilis*, recently collected by the authors in Cuba. In this aquatic colubrid snake, the pupil is small and vertically elongated. Here, again, it was found that the pupil tended to remain vertical while the head was tilted through a wide angle; and, as in the crotalid and boid species, the vertical position of the pupil was maintained through a greater tilt of the head upward than downward (as Munro observed in his specimens).

It was of interest to note the occurence of the same pupil mechanism in crocodilians. Observations were made on the American alligator *(Alligator mississipiensis)*, the American crocodile *(Crocodylus acutus)*, and on juvenile Central American caymans (*Caiman* sp.).

Munro suggested that the pit viper's ability to maintain a vertical pupil was perhaps an adaptation for more efficient "striking", stating that "the venomous reptile ... can strike its active prey properly only by carefully estimating the distance" *(op. cit.:* 108). With this hypothesis we are somewhat at variance; the facial pit, not the eye, is the important sense organ in the striking of crotalid snakes (*cf.* Noble and Schmidt, 1937; Proc. Amer. Phil. Soc. 77 (33): 263 *et seq.*). Furthermore, the ability to maintain a vertical pupil is evident in forms which do not "strike", either in foraging or in defense. *Tretanorhinus*, for example, forages by crawling about on the bottom of shallow streams by night, nosing into holes and crevices, and also by swimming open-mouthed through schools of minnows in shallow water; it does not attempt to strike when molested. The crocodilians, likewise, may lunge at prey, but could scarcely be said to "strike". Apparently the ability to maintain a vertical pupil is a widespread phenomenon among reptiles.

--Silver Springs, Florida

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